

Membrane Separation Technology for Biobased Products



Need

Millions of pounds of toxic, petroleum-based chemicals and solvents are used by industry each year. Efforts to replace these products — which can damage the ozone layer and pollute groundwater — with environmentally benign products have often been thwarted by the high cost of developing chemicals and other bioproducts from agricultural feedstocks.

Argonne Solution

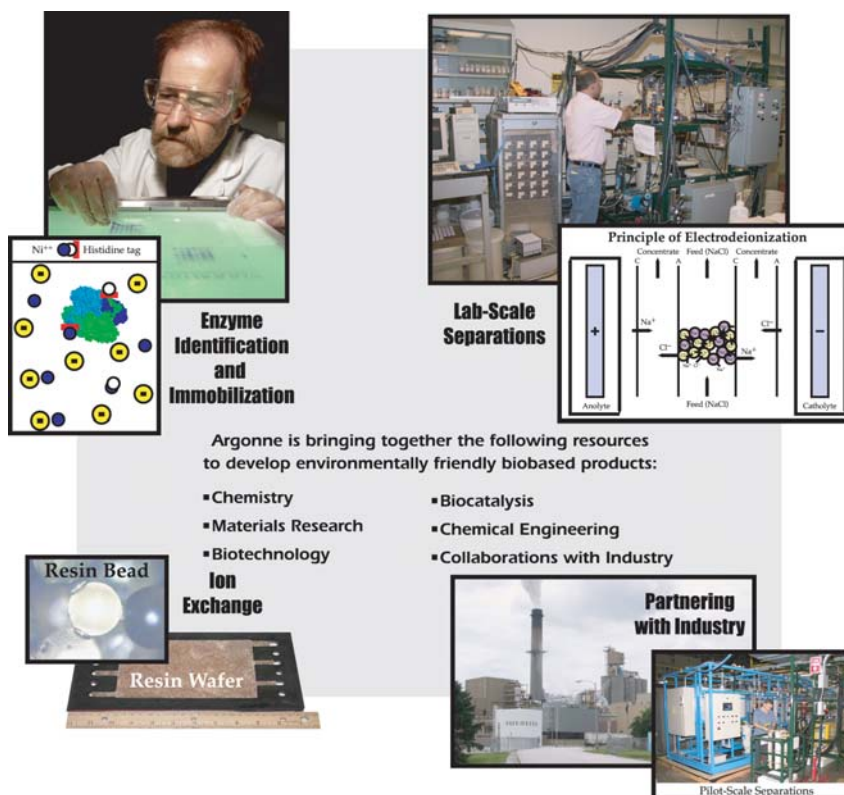
In a collaborative effort with industry, Argonne is integrating membrane-separation technologies with biotechnology to produce valuable chemicals, "green" solvents, and other biobased products cost-effectively from Midwest agricultural feedstocks, as a replacement for petroleum-based products. Product separation from complex starting materials typically limits their potential use. Argonne addresses this barrier with membrane-separation technologies that include electro-assisted membrane separations

and immobilized enzymes and with identification of novel membrane materials and enzymes.

The biotechnology revolution integrates many fields of study. The goal in this program is to apply Argonne's expertise in the various fields to cost-effectively solve real-world problems for industry and government.

Approach

Argonne research has focused on downstream separations, using advanced membranes for both chemical and biological processes, and on integrating pathway design (metabolic engineering) with downstream processing. Research programs include: fermentation and biocatalytic operating systems to produce vitamin C from corn (joint venture with Eastman Chemical, Genencor, Electrosynthesis, and Microgenomics), advanced bioprocess and



separation technologies for novel product synthesis and purification, and waste stream reduction. Argonne is working with several industrial partners (Vertec Biosolvents, Inc. ED Sep Inc., Purolite, A.E. Staley, and Archer Daniels Midland) to:

- (1) identify and optimize enzymes for catalysis and
- (2) develop membrane materials and integrate them into membrane separation technologies to reduce the number of processing steps, decrease waste streams, improve product yield, and create new products.

Achievements

Argonne developed and licensed an economical membrane-based process to produce environmentally friendly solvents based on ethyl lactate esters that could replace up to 85% of toxic and chlorinated petrochemical solvents now used in industry.

Argonne researchers have developed an international reputation for their biobased chemicals programs and have received several national awards, including a Discover Magazine Award for

Technological Innovation (environmental category), a Presidential Challenge Green Chemistry Award, an *R&D Magazine* R&D 100 Award, the U.S. Department of Energy (DOE) Technology of the Year (finalist), the Theile Award, the Bright Lights 2000 Award, and the Federal Laboratory Consortium Award for Technology Transfer. Argonne staff have also formed a Midwest Consortium for Biobased Products and Bioenergy with DOE Ames, University of Illinois, Purdue, Michigan State, and Iowa State Universities and the U.S. Department of Agriculture (Peoria Office) to create a major geographic center for the biobased products industry.

Impact

Successful implementation of the technologies developed at Argonne will help reduce U.S. dependence on petroleum, alleviate adverse environmental effects of industrial chemicals and solvents, and provide a growing market for Midwest agricultural products.

Sponsors

U.S. Department of Energy, Office of Industrial Technology
State of Illinois Department of Commerce and Community Affairs

Collaborators

Vertec Biosolvents, Inc.
ED Sep Inc.
Purolite Inc.
A.E. Staley (U.S. subsidiary of Tate and Lyle)
Archer Daniels Midland
Midwest Consortium for Biobased Products and Bioenergy

Contact

Seth W. Snyder
Energy Systems Division
Phone: 630/252-7939
Fax: 630/252-9281
E-mail: seth@anl.gov



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